HR-208 Alternative Method of Stabilizing the Degrading Stream Channels in Western Iowa

Key Words: Stream stabilization, Loess soils, Gabion structure, Erosion control

ABSTRACT

Since the turn of the century, tributaries to the Missouri River in western Iowa have entrenched their channels to as much as six times their original depth. This channel degradation is accompanied by widening as the channel side slopes become unstable and landslides occur. The deepening and widening of these streams have endangered about 25% of the highway bridges in 13 counties.

Grade stabilization structures have been recommended as the most effective remedial measure for stream degradation. In western Iowa, within the last seven years, reinforced concrete grade stabilization structures have cost between $300,000 and $1,200,000. Recognizing that the high cost of these structures may be prohibitive in many situations, the Iowa Department of Transportation (Iowa DOT) sponsored a study at Iowa State University (ISU) to find low-cost alternative structures. This was Phase I of the stream degradation study. Analytical and laboratory work led to the conclusion that alternative construction materials such as gabions and soil-cement might result in more economical structures [Lohnes et al. 1980]. The ISU study also recommended that six experimental structures be built and their performance evaluated. Phase II involved the design of the demonstration structures, and Phase III included monitoring and evaluating their performance.

The gabion grade stabilization structure has shown satisfactory structural performance throughout the two-year observation period, with minimal differential settling and no evidence of side slope instability since construction was finished. It should be recognized that the maximum flow to date has been less than 15% of the design flow.

The major amount of sedimentation occurred during construction and is likely to extend at least 5,500 ft upstream of the structure. A more optimistic estimate is that the depositional wedge will extend 6,500 ft upstream. In any event the sedimentation effects of the structure will not submerge the knickpoint that exists upstream, so continued upstream erosion problems are likely upstream of the sedimentation area.

The sedimentation beneath the bridge has been sufficient to cover the piles to their original depth of soil cover and to stabilize the slope beneath the abutment

Erosion downstream of the structure could be a problem, especially if it undermines the stilling basin. On

the other hand, the gabions are deformable and may collapse into any scour hole that forms, thereby becoming somewhat self protecting. This downstream erosion is the result of inefficient energy dissipation by the stilling basin.

An analysis of the cost of the gabion structure as compared with costs of four concrete structures included the size, drainage area, and design flow of each of the structures. This analysis suggests that the gabion structure cost about 20% of what an equivalent concrete structure would have cost.